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IN OPEN SPACE -- VOSKHOD-2 SPACECRAFT DESIGN

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ABSTRACT

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Abridged versions of two official documents issued by the USSR Federation of Aviation Sports in connection with the orbital flight of the Soviet cosmonauts Belyayev and Leonov on Mar. 18, 1965. The documents are (1) a statement on the maximum distance of movements of Leonov outside the spacecraft, and (2) a report containing a comprehensive description of the design, instrumentation, and operation of the spacecraft (Voskhod-2).

The International Aviation Federation (IAF) has advised the Aviation Federation of the USSR that the outstanding achievements of the Soviet cosmonauts P.I. Belyayev and A.A. Leonov have set a definite world record. /17*

The altitude of the orbital flight was 497.7 kilometers. The previous record (408 kilometers) also belonged to the Soviet cosmonauts.

Cosmonaut A.A. Leonov set the world's record for remaining in space outside of the spacecraft -- which was 12 minutes. Although this record was recently duplicated by an American cosmonaut, it will always remain as the first of the unprecedented feats of mankind.

We are publishing individual documents in an abridged form from "Record of the First Flight in the World with a Man Walking in Space" on the spacecraft "Voskhod-2".

STATEMENT

DETERMINATION OF THE DISTANCE COSMONAUT LEONOV ALEKSEY ARKHIPOVICH
MOVED AWAY FROM THE SPACECRAFT "VOSKHOD-2" IN A PRESSURIZED SUIT
WITH AN AUTONOMOUS LIFE SUPPORT SYSTEM ON MARCH 18, 1965

* Note: Numbers in the margin indicate pagination in the original foreign text.

We, the undersigned, the sport commissars of the Aviation Federation of the USSR, Anokhin Sergey Nikolayevich and Kuvshinov Leonid Mikhaylovich, have formulated the present statement with respect to the following:

After having determined the length of the walk and after having studied all of the television data and the photographic data recording the cosmonaut leaving the spacecraft and walking in space, and returning to the spacecraft, we testify that the cosmonaut Leonov A. A. walked freely in space a maximum distance from the transfer chamber of the spacecraft of 5.35 meters.

Supplement:

1. Determination of the length of the walk.
2. Establishment of the C-97 motion picture camera recording the cosmonaut walking in space.

The Sport Commissars of the Aviation Federation of the USSR,
S. N. Anokhin, L. M. Kuvshinov.

REPORT

CONSTRUCTION OF THE SPACECRAFT "VOSKHOD-2"
AND ITS SPECIAL EQUIPMENT.

The spacecraft "Voskhod-2" is a manned, two-seater rocket/^{device} based on the spacecraft "Voskod", enabling a cosmonaut to walk out into space from the spacecraft.

The spacecraft crew is comprised of the spacecraft commander and the second pilot.

During the orbital flight, the second cosmonaut was the first in the world to leave the spacecraft and walk in space.

The second pilot left the spacecraft and subsequently returned to it by means of a transfer chamber method.

The walk in space by the second pilot and the flight of the cosmonauts in the spacecraft were performed in special pressurized suits.

The spacecraft consists of:

Hermetic cabins containing the crew, the life support equipment, the food and water supply, the instruments for controlling and directing the operation of the spacecraft on-board systems, a portion of the radio equipment, television cameras, a video control device, movie camera and camera, apparatus for medical and scientific studies, and direction-finders during launch and re-entry;

- An instrument compartment containing the radio equipment for the spacecraft, a liquid braking engine, a control device, a temperature regulation system, and a current source.

The spacecraft carries a reserve powder braking engine, a primary redundant braking engine, and a transfer chamber for the cosmonaut to walk into /18 space and return to the spacecraft.

After the orbital flight, the hermetic cabin, as well as the crew and the equipment located in it, returns to earth.

For protection from high temperatures during launch, the outside of the hermetic cabin is covered with a special thermal insulation. There are three portholes in the cabin.

The porthole construction provides the requisite pressurization of the cabin during all phases of the flight. After reaching the earth, the crew may leave the spacecraft cabin through any of these portholes.

There are three illuminators in the cabin, by means of which the crew can perform visual observations, take moving pictures, and take regular photographs. The illuminators have heat-proof glass designed for the high

temperatures affecting the surface when the spacecraft enters the dense atmospheric layers.

The illuminators have screens.

Chairs are provided for the crew which are molded to the shape of the cosmonaut's body.

The instrument compartment of the spacecraft is a hermetic chamber containing equipment and the braking engine.

The outside of the instrument compartment contains tanks with compressed gas reserves, the spacecraft orientation system engine, tanks with compressed oxygen and air for ventilating the pressurized suits and supplying the crew with oxygen should the cabin become accidentally de-pressurized, antennae of the spacecraft radio system, and a radiator for the temperature regulation system.

When the spacecraft returns to Earth, the instrument compartment is separated from the spacecraft and burns up in the dense atmospheric layers.

The transfer chamber is located in the spacecraft cabin, and communication with the cabin is possible by means of a porthole having a hermetic cover.

The porthole cover may be opened within the pressurized cabin, and may be opened and closed automatically by means of a special electric drive mechanism. The drive mechanism is controlled from a panel. When necessary, the cover may be opened and closed by hand.

A porthole in the upper part of the transfer chamber -- which has a hermetic cover and which may be opened by means of the electric drive mechanism -- enables the cosmonaut to leave the transfer chamber and walk in space. However, it may also be opened and closed by hand.

The transfer chamber contains two movie cameras for recording the

cosmonaut entering the chamber and leaving it, an illumination system, a control panel, and the transfer chamber apparatus.

Outside of the transfer chamber there is a movie camera for photographing the cosmonaut in space, tanks with an air reserve for charging the transfer chamber, and tanks with an emergency reserve of oxygen.

After the program is completed during which the cosmonaut walks in space, the transfer chamber is separated from the spacecraft.

A special pressurized suit has been developed for the cosmonaut to walk in space.

The pressurized suit has several layers of hermetic covering, thus enabling the cosmonaut to maintain overpressure within the pressurized suit while walking in space, and provides for normal life support.

The helmet of the pressurized suit has double, hermetic glass windows and a protective filter which provide the cosmonaut with the requisite field of view and protect his eyes from the solar rays.

Both crew members have similar pressurized suits, so that the spacecraft commander could help the cosmonaut walking in space if necessary.

Ventilation systems for the pressurized suits and an oxygen supply/^{system}for the crew are included in order to provide the requisite living conditions while the cosmonauts are in the spacecraft and while one of them walks in space.

While the cosmonauts are in the cabin, the pressurized suits are ventilated by the cabin air. In the event of de-pressurization, the oxygen supply and ventilation are automatically switched on from the reserves of compressed oxygen and air located on the spacecraft.

When he walks out into space and during the entire period of time he remains there, the second pilot is supplied with oxygen from tanks located

on the back of the pressurized suit.

The commander of the spacecraft controls the transfer from a panel located in the cabin.

When necessary, the second pilot can control the main transfer operations from the panel in the transfer chamber.

The spacecraft may be controlled automatically and manually.

Manual control equipment enables the crew to orient the spacecraft in space manually during flight and during launch, and to land it in a selected region by employing any of the braking engines -- the main engine (liquid) or the reserve engine (solid fuel).

During manual control, the crew employs an optical orienting device to determine the flight direction and the local vertical, or ion plots /19 of the spacecraft velocity vector.

The signals from the ion plots of the spacecraft velocity vector are indexed by the video control device of the spacecraft television system.

During flight and descent, the automatic control equipment makes it possible to control the on-board systems by a given program and the system for orienting the spacecraft in space. This equipment also makes it possible to land the spacecraft in a given region by means of the main (liquid) braking engine.

When the spacecraft is automatically launched from orbit, the engine axis is directed toward the Sun by means of a photoelectron solar sensor.

The spacecraft carries a two-way communication link between the crew and points on the Earth before launch, during the ascent phase, and during

orbital flight, as well as a two-way communication link between the cosmonaut walking in space and the commander of the spacecraft.

The spacecraft carries two short-wave receivers and transmitters, two ultrashort-wave receivers and transmitters, a magnetophone, a broadcasting receiver, and electroacoustical equipment.

The frequencies of the on-board transmitters are 17,365; 18,035; and 143,625 Mc.

The crew selects the form of radio communication, switching on a certain channel.

The television system is designed in such a way that points on the Earth as well as the crew member remaining in the spacecraft may observe the cosmonaut walking in space. It is also designed to observe the crew within the spacecraft, to obtain objective data on the condition of the cosmonauts, their behavior, and movement coordination while performing different operations.

The television system has two cameras for external observations, two cameras and a video control device within the cabin.

The equipment for controlling and recording the physiological functions of the crew during flight (pulse rate, breathing, etc.) makes it possible to observe the condition of the crew continuously.

Radiotelemetry equipment, an automatic recording system, and a sensing element control and record the operation of the spacecraft equipment during flight.

In addition, the spacecraft carries a "Signal" radio system which operates at a frequency of 19,996 Mc, a radio device for controlling the spacecraft orbit during the ascent phase and during orbital flight, and

equipment for recording the dose of ionizing radiation.

A conditioning system is employed to ensure the fact that the main parameters of the cabin microclimate are close to the norm. This system also provides for the absorption of carbon dioxide and moisture, and liberates the requisite amount of oxygen for the crew to breathe. The amount of oxygen liberated by the system is automatically controlled.

The conditioning system also absorbs harmful admixtures resulting from the activity of the crew and the operation of the equipment.

A pressure control system is included in order to maintain normal pressure in the cabin.

The food and water supply system provides the crew with food and water during the entire flight.

An automatic temperature control system is carried on the spacecraft to maintain the temperature regime of the spacecraft within given limits.

The system consists of two circuits: an air circuit which opens into the cabin and a liquid circuit which is connected to the radiation heat transmitter located in the instrument compartment. Both circuits are connected at the air-liquid heat exchanger located in the spacecraft cabin. This system may be used by the crew to maintain and regulate the temperature within the spacecraft between $+12$ $+27^{\circ}$ C.

The cabin illumination system consists of pilot and operational illumination. It is controlled on a panel, and the crew can switch the illumination on and off. The system provides illumination ranging between 5 - 70 lux.

The landing system provides a safe landing for the crew and spacecraft, and a landing with almost zero vertical velocity.

The device employed by the crew to determine the location of the spacecraft on the orbit and the geographical coordinates of the desired landing

spot is in the shape of a globe with a scale of 1:100 000 000.

The globe rotates simultaneously with respect to two axes. The rotation with respect to the first axis corresponds to the Earth's rotation around its axis, taking into account a correction for precession of the spacecraft orbit. The rotation with respect to the second axis corresponds to the orbital motion of the spacecraft.

Thus, the cross lines on the glass face of this device show the location over which the spacecraft is flying at each moment.

The desired landing spot is found by the rotation of the globe by the bias angle corresponding to the calculated descent angle, computed from the time the braking engine is switched on up to the landing spot.

The globe construction makes it possible to introduce the requisite corrections for the operation of the device based on the results of actual changes in the orbital parameters.

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